

REMARKS

Claims 1 - 20 remain active in this application. Claims 10 - 20 have been withdrawn from consideration as being non-elected, with traverse, in response to requirements for restriction and election of species. Claims 11 - 20 have been canceled. The specification has been reviewed and editorial revisions made where seen to be appropriate, particularly in response to further criticisms by the Examiner and other minor editorial revisions which are not substantive. No new matter has been introduced into the application.

The Examiner has adhered to the requirements for restriction and election of species. The traverse of the requirement for election of species is respectfully maintained particularly since generic claims are clearly present and, if found to be allowable, rejoinder must be permitted. Therefore claims 11 - 20 have been canceled but claim 10 has been retained and it is respectfully submitted that such action is entirely appropriate under the circumstances to respond to the present requirement for cancellation or other appropriate action in regard to the non-elected claims.

The Examiner has objected to the drawings in regard to reference numerals 120, 320 and 730. This objection is respectfully traversed as being moot in view of the above amendments to the specification in which "120" has been corrected to "130" and reference numerals 320 and 730 have been inserted in appropriate locations in the specifications. Accordingly, it is respectfully submitted that the Examiner's objections have been fully answered and the application is in full compliance with 37 C.F.R. §1.84 and reconsideration and withdrawal of the objections is respectfully requested while no further

changes to the drawings are necessary.

Claims 1 - 5 have been rejected under 35 U.S.C. §102 as being anticipated by Li. This ground of rejection is respectfully traversed.

The invention is directed to the problem of achieving improved adhesive and mechanical strength of connection while minimizing adverse electrical effects of the presence of an alloy including a material having increased adhesive properties in a metal or alloy connection. This is achieved by limiting the quantity of alloying material by deposition of a layer of the material of well-defined thickness, confining the material on one side by a diffusion barrier and forming an alloy which reacts all of the material in the layer such that the alloy becomes highly stable and distribution of the alloying material is confined in the direction away from the diffusion barrier to about one diffusion length of the material. The stable distribution of material thus achieved also achieves graded mechanical characteristics.

Li is concerned with adhesion of copper to a diffusion barrier but is principally concerned with the volume occupied by an adhesion layer, an intermediate layer and a seed layer within a trench during formation of Damascene conductors (column 2, lines 38 - 46). Thus Li proposes a deposition process which provides deposition of layers of one atomic thickness per deposition cycle. These layers are formed of alternating materials with the number of layers (e.g. 10 to 50 cycles for each material in the examples of Li) of each material determining the composition which thus can be a graded composition that forms a composite "barrier-adhesion-seed layer" (column 5, lines 30 - 37) comprised of discrete sub-layers which may be graded from sub-layer to sub-

layer. However, there is no disclosure seen in Li et al. that these multiple sub-layers have graded mechanical characteristics or, more importantly, are stable against diffusion of the materials therein. The Examiner has not attempted to assert inherency in this regard and, it is respectfully submitted, cannot properly do so, particularly since the composition of the sub-layers vary from layer to layer and necessarily present an interface between sub-layers which are different in composition. Further, there is no indication seen in Li that the diffusion barrier is intended to prevent diffusion of any material other than copper (see column 1, line 54, to column 2, line 9) while claim 1 recites that it is the alloy of the interlayer connection and thus alloying materials therein which is confined by the claimed barrier layer.

Therefore, it is clearly seen that Li does not anticipate claim 1 or any claim depending therefrom. accordingly, reconsideration and withdrawal of this ground of rejection are respectfully requested.

Claims 1 - 4, 6 and 7 have been rejected under 35 U.S.C. §103 as being unpatentable over Besser et al. in view of Lopatin et al.. and claim 5 has been rejected under 35 U.S.C. §103 as being unpatentable over Besser et al. in view of Lopatin et al. and Wang et al. These grounds of rejection are also respectfully traversed.

Besser et al. was discussed in detail in the response filed May 8, 2006, in response to a rejection of claims 1 - 4, 6 and 7 under 35 U.S.C. §102 as being anticipated by Besser et al.; which discussion is hereby fully incorporated by reference. In summary thereof, Besser et al. is directed to forming a solid solution of an alloying element in a conductor. The alloying material is supplied by implantation and is stated to be

non-critical as to both quantity and distribution. There is no teaching or suggestion of developing stability of alloying material distribution or development of graded mechanical properties therein or even the desirability thereof. Therefore, that argument is certainly indicative of the insufficiency of Besser et al. under 35 U.S.C. §103 as well, if not more so, and the Examiner now admits that Besser et al. fails to teach or suggest the development of a stable alloy or graded mechanical properties.

Lopatin et al. clearly fails to mitigate these deficiencies of Besser et al. for much the same reasons discussed above in regard to Li. Lopatin et al. teaches formation of a composite seed layer 224 comprising a plurality of discrete sub-layers which are graded in composition from layer to layer in nitrogen content which is successively reduced in a copper-tin alloy from layer 225 to layer 227 which is nitrogen free. There is no indication in Lopatin that the relative proportions of copper and tin (or other alloying metals; magnesium and aluminum being disclosed) is varied between layers or that the resulting composite seed layer 224 has graded mechanical characteristics or stability of composition but merely (as in Li) that the nitrogen content allows alloying to the barrier layer for good adhesion thereto while the lack of nitrogen favors alloying to copper with good adhesion. Wang et al., being cited only for particular barrier layer materials, clearly does not mitigate the deficiency of Besser et al. and Lopatin et al. and the Examiner has not asserted that it does.

Therefore it is respectfully submitted that the Examiner has not made and cannot make a *prima facie* demonstration of obviousness based on Besser et al., Lopatin et al. and/or Wang et al. None of these

references taken alone or in any combination provides evidence of a level of ordinary skill in the art which would support the conclusion of obviousness which the Examiner has asserted for the simple reason that they do not lead to an expectation of success in deriving the meritorious effects of the invention in providing a compositionally stable thin region which has graded mechanical characteristics such as coefficient of thermal expansion such that mechanical stresses applied thereto are not concentrated at interfaces. Thus it is respectfully submitted that these grounds of rejection are clearly in error and, upon reconsideration, withdrawal thereof is respectfully requested.

It is respectfully submitted that the above-requested amendments should be entered since they are limited to matters of form and, since no amendments have been requested in the claims, cannot raise any new issue requiring further consideration. Therefore, entry of the above-requested amendments is respectfully requested.

Since all rejections, objections and requirements contained in the outstanding official action have been fully answered and shown to be in error and/or inapplicable to the present claims, it is respectfully submitted that reconsideration is now in order under the provisions of 37 C.F.R. §1.111(b) and such reconsideration is respectfully requested. Upon reconsideration, it is also respectfully submitted that this application is in condition for allowance and such action is therefore respectfully requested.

If an extension of time is required for this response to be considered as being timely filed, a conditional petition is hereby made for such extension of time. Please charge any deficiencies in fees and credit any overpayment of fees to Deposit Account No. 09-0458 of

International Business Machines Corporation (East
Fishkill).

Respectfully submitted,

A handwritten signature in cursive script, appearing to read "Marshall M. Curtis".

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